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I HEREBY CERTIFY that annexed hereto is a true copy of documents filed in connection with the following patent application:

Application No.	S2004/0023
Date of Filing	15 January 2004
Applicant	ELEMENT SIX LIMITED, an Irish company of Shannon Airport, Shannon, County Clare, Ireland.

Dated this 18 day of January 2005.

PRIORITY DOCUMENT
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FORM NO. 1

REQUEST FOR THE GRANT OF A PATENT

PATENTS ACT, 1992

The Applicant(s) named herein hereby request(s)

[ ] the grant of a patent under Part II of the Act

[x] the grant of a short-term patent under Part III of the Act

on the basis of the information furnished hereunder.

1. Applicant(s)

Name Element Six Limited

Address Shannon Airport, Shannon, County Clare, Ireland.

Description/Nationality A company registered according to the laws of Ireland.

2. Title of Invention

Coated Abrasives.

Declaration of Priority on basis of previously filed application(s) for same invention (Sections 25 & 26)

Previous filing date	Country in or for which filed	Filing No.

4. Identification of Inventor(s)

Name(s) of person(s) believed by Applicant(s) to be the inventor(s)

Fish, Michael Lester	Egan, David Patrick	Engels, Johannes Alexander
Address Solas, Ballaghboy, Ennis, County Clare, Ireland.	Berra, Kilkishen, County Clare, Ireland.	Clonbunny, Newport, County Tipperary, Ireland.

5. Statement of right to be granted a patent (Section 17(2)(b))

The Applicant acquired the rights in the invention by virtue of the inventors' Contracts of Employment.

6. Items accompanying this Request - tick as appropriate

(i)	x	Prescribed filing fee (€ 60)
(ii)		Specification containing a description and claims
	x	Specification containing a description only
		Drawings referred to in description or claims
(iii)		An abstract
(iv)		Copy of previous application(s) whose priority is claimed
(v)		Translation of previous application whose priority is claimed
(vi)		Authorisation of Agent (this may be given at 8 below if this Request is signed by the Applicant(s))

7. Divisional Application(s)

The following information is applicable to the present application which is made under Section 24 -

Earlier Application No: ....
Filing Date: ....

Agent

The following is authorised to act as agent in all proceedings connected with the obtaining of a patent to which this request relates and in relation to any patent granted -

Name	Address
ANNE RYAN & CO.	60 Northumberland Road, Ballsbridge, Dublin 4, Ireland.

9. Address for Service (if different from that at 8)

ANNE RYAN & CO., Authorised Patent Agents.

Signed Name(s): by: [illegible]
Capacity (if applicant is a body corporate):

Date January 15, 2004

BACKGROUND OF THE INVENTION

This invention relates to coated abrasives, a process for their production, and to coated abrasives for use in abrasive-containing tools.

Abrasive particles such as diamond and cubic boron nitride are commonly used in cutting, grinding, drilling, sawing and polishing applications. In such applications, abrasive particles are mixed with metal powder mixes, then sintered at high temperatures to form bonded cutting elements. Typical bond matrices contain iron, cobalt, copper, nickel and/or alloys thereof.

Common problems in applications are retention of particles in the bond matrix, and resistance against oxidative attack during the sintering process and the subsequent application.

These problems are commonly addressed by coating the abrasive particles with metals or alloys which bond chemically to the particle, and alloy to the bond matrix. Typically, chemical vapour deposition (CVD) or physical vapour deposition (PVD sputter coating) techniques are used. Titanium carbide is an example of a material that has been proposed as a coating for abrasive particles, because of its good adhesion to diamond. Chromium carbide is a similar coating material that can be used.

A problem with the use of titanium carbide coatings is that in order for the coating to protect the diamond particles, it has to form a barrier between the bond matrix and the particles. In other words, it should be impermeable and dense, so that components of the bond matrix are unable to pass through and make contact with the particle surface. One way the components could pass through the coating is by solid-state diffusion through the coating. Alternatively, if the coating is incomplete, cracked or porous, components may pass through the coating to reach the particle surface. A coating may initially be dense and impermeable, but during the sintering process, a phase change may occur due to alloying with the bond matrix, for example, which results in the formation of a less dense alloy, or perhaps a porous coating, which allows passage of the bond matrix components through the coating to the particle surface. Titanium carbide coatings often do not form good barriers, particularly in aggressive sintering conditions.

SUMMARY OF THE INVENTION

A coated super-hard abrasive comprising a core of super-hard abrasive material, an inner layer of a metal carbide, nitride, boride, carbonitride or boronitride chemically bonded to an outer surface of the super-hard abrasive material and an outer layer of a metal, metal alloy or a combination of metals or metal alloys deposited on the inner layer.

Examples of metals or metal alloys that can be applied as an outer layer include metals from group IVa, Va or VIa transition metals, including tungsten, titanium, chromium, molybdenum, and zirconium, and metals from the first row transition metals (Ti to Cu), particularly the non magnetic metals or alloys of these that are amenable to magnetron sputtering, and elements from groups IIIb and IVb of the periodic table, such as B, Al, Si. Alloys might include the metals mentioned above with metals selected from the platinum group metals and metals from group Ib. Examples are

aluminium-, copper- or nickel- titanium. An example of a non magnetic alloy from the first row transition metals is nickel – 20 weight % chromium.

The outer layer is preferably applied by physical vapour deposition, in particular by PVD sputter coating.

The super-hard abrasive material may be diamond or cBN based, and may include diamond or cBN grit, PCD substrates, PcBN substrates, thermally stable PCD (TSPCD) substrates, CVD diamond film, single crystal diamond substrates.

The inner layer is formed from an element capable of forming (singly or in combination) carbides, nitrides or borides to the surface(s) of the abrasive material when applied as an inner layer using a hot coating process. Typically these elements come from groups IVa, Va, VIIa, IIIb and IVb of the periodic table and include examples such as Ti, Cr, Zr, Mo, Ta, W, Al, B and Si. The inner layer is preferably a titanium or chromium carbide coating in the case of a diamond abrasive core, or a titanium or chromium nitride, boride or boronitride coating in the case of a cBN abrasive core.

The properties of the metal layer may be tailored for better compatibility with the inner layer or for better bonding with metal bond matrices.

DESCRIPTION OF PREFERRED EMBODIMENTS

Whilst the invention extends to various forms of coated abrasive material, it will in the most part be described with reference to the coating of diamond grit for convenience.

Ti in the form of titanium carbide or titanium nitrides, borides and boronitrides have been shown to be useful coating materials for diamond and cBN substrates, respectively. They are particularly useful because of their ability to bind chemically to the substrate and to protect the substrate.

However, as has been mentioned previously, they are not suitable in some applications, particularly where they are sintered in aggressive sintering conditions. They are also prone to problems with bonding properly with the bond matrix.

It has been found that the advantages of titanium coatings can be extended to other applications where an outer metal coating is applied over the titanium coating layer. This is particularly the case where the titanium coating is prone to deterioration and where there is poor bonding with the metal matrix.

It is especially useful in the making of diamond impregnated tools such as segments for saw blades, drills, beads for diamond wires especially where high amounts of bronze or copper limit the usefulness of titanium carbide coatings, the making of brazed diamond layer tools such as brazed diamond wire beads, the making of diamond containing metal matrix composites, brazing of diamond materials such as affixing TSPCD, PCD and diamond drillstones to a drill body, affixing CVD, monocrystal, TSPCD and PCD to a saw blade, tool post, drill body and the like.

Additionally, the coated diamond impregnated tools yield improved performance, such as longer tool life and higher productivity. Coated diamond particles or substrates of the invention for brazing applications allow the use of simple brazes that work in air as opposed to active brazes containing Ti which require the exclusion of oxygen.

The coated abrasive particles are preferably formed using a hot coating process for applying the inner layer and a low temperature CVD or PVD process for applying the outer layer.

The diamond grit particles are those used conventionally in the manufacturing of metal bonded tools. They are generally uniformly sized, typically 0.1 to 10 mm. Examples of such diamond grit particles include: Micron grit 0.1 to 60 micron, wheel grit 40 micron to 200 micron, saw grit

180 micron to 2 millimeter, mono crystal 1 millimeter to 10 millimeter, CVD inserts of a few square millimeter to discs up to 200 millimeter diameter, PCD inserts of a few square millimeter to discs 104 millimeter diameter, cBN grit in micron range 0.1 to 60 micron, in wheel grit range 40 micron to 200 micron, PCBN inserts of a few mm to discs up to 104 mm diameter.

The diamond particles are first coated in a hot coating process to provide an inner layer, which may be a metal layer or a metal carbide, nitride or carbonitride layer. In the case of cBN, such inner coating would typically be a metal nitride or boride or boronitride layer. In this hot coating process, the metal-based coat is applied to the diamond substrate under suitable hot conditions for such bonding to take place. Typical hot coating technologies that can be used include processes involving deposition from a metal halide gas phase, CVD processes, or thermodiffusion vacuum coating or metal vapour deposition processes, for example. Deposition from a metal halide gas phase and CVD processes are preferred, with processes involving deposition from a metal halide gas phase being particularly preferred.

In processes involving deposition from a metal halide gas phase, the particles to be coated are exposed to a metal-halide containing the metal to be coated (e.g. titanium) in an appropriate gaseous environment (e.g. non-oxidising environments containing one or more of the following: inert gas, hydrogen, hydrocarbon, reduced pressure). The metal halide may be generated from a metal as part of the process.

The mixture is subjected to a heat cycle during which the metal-halide transports the titanium to the surfaces of the particles where it is released and is chemically bonded to the particles.

The outer layer of metal, metal alloy or combination of metals or metal alloys is deposited using a cold coating technique such as low temperature CVD or PVD, which is preferred. It is a low temperature process in that insufficient heat is generated to cause significant carbide formation. Hence, if used alone, it would result in poor adhesion to the diamond

particles. An example of a PVD process for applying the outer coating is PVD sputtering. In this method, the metals, metal alloys or multiple layers of metal are deposited on the inner layer. The sputtering can take place from different positions, using more than one metal/metal alloy. This allows for the production of metallic outer layers that bond better with the bond matrix. They can also be tailored to provide for improved chemical resistance, tailored melt point, and improved resistance to diffusion reactions and the tendency to alloy with the bond matrix.

Examples of coated abrasives of the invention include:

Titanium carbide coating applied by a hot coating process, such as the commercially available SDBTCH, with an outer coating of:

i) titanium, which improves oxidation resistance,

ii) tungsten, which provides for improved chemical resistance.

ANNE RYAN & CO.
AGENTS FOR THE APPLICANTS